JUN 0 8 1988 466-A-3 ED 1.310/2:285319

DMINISTRATIVE GUIDELINES FOR THE IMPLEMENTATION OF TECHNOLOGY IN SPECIAL EDUCATION

ED285319

COMPLETED
57

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☑ This document has been reproduced as received from the person or organization originating it
☐ Minor changes have been made to improve reproduction quality
● Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

EC200256

CEC ERIC

Linda Rice White

DOCUMENT RESUME

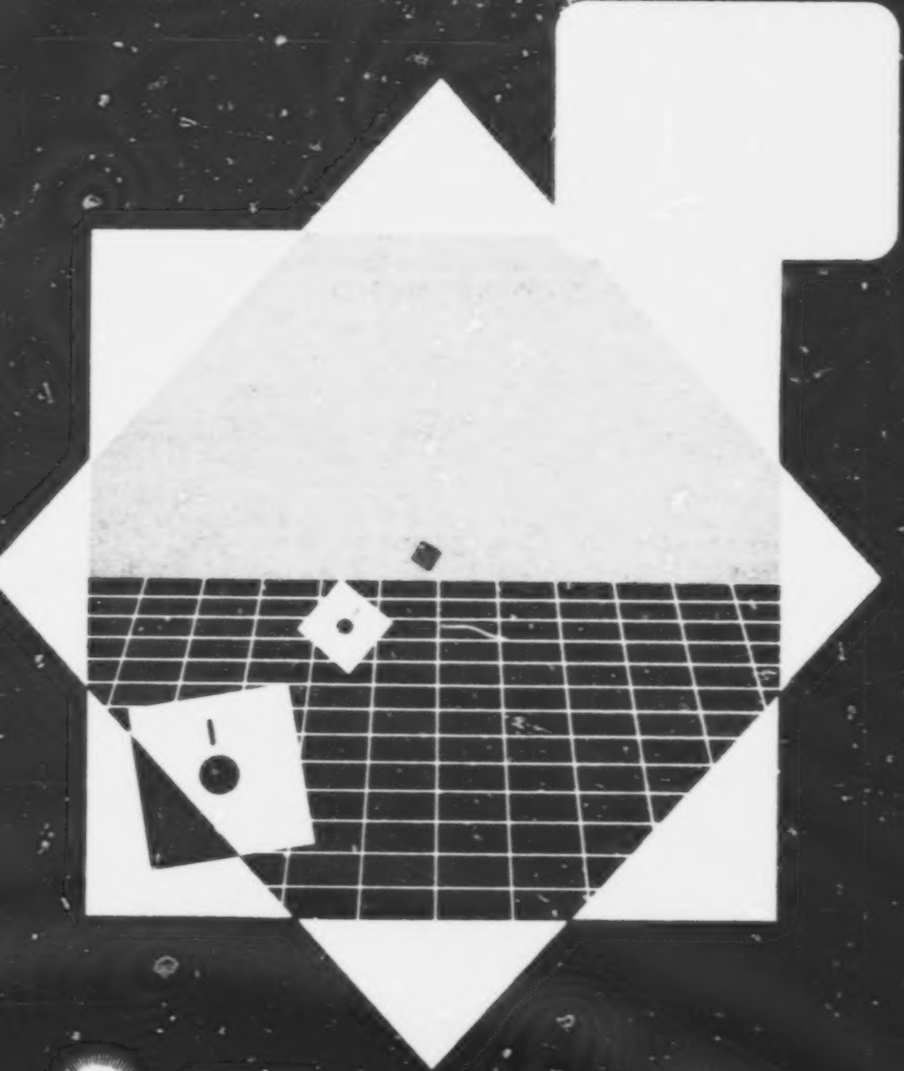
ED 285 319 EC 200 256

AUTHOR	White, Linda Rice
TITLE	Administrative Guidelines for the Implementation of Technology in Special Education.
INSTITUTION	Council for Exceptional Children, Reston, Va.; ERIC Clearinghouse on Handicapped and Gifted Children, Reston, Va.
SPONS AGENCY	Office of Educational Research and Improvement (ED), Washington, DC.
REPORT NO	ISBN-0-86586-173-0
PUB DATE	87
CONTRACT	400-84-0010
NOTE	56p.
AVAILABLE FROM	Council for Exceptional Children, Publication Sales, 1920 Association Dr., Reston, VA 20091 ($11.70, $9.95 member price; Stock No. 319).
PUB TYPE	Guides - Non-Classroom Use (055) -- RepoInformation Analyses - ERIC Information Analysis Produc
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Administrator Guides; Administrator Role; Assistive Devices (for Disabled); *Computer Assisted Instruction; *Computers; Computer Software; Courseware; *Disabilities; *Educational Technology; Elementary Secondary Education; Microcomputers; *Program Implementation; *Special Education

ABSTRACT

Targeted at special education administrators who are involved in making decisions regarding the use of microcomputers in instructional programs for handicapped students, this document offers guidelines which synthesize relevant data on computer technology in special education and provide a framework for implementing classroom use of the microcomputer. Thirteen guidelines are presented in the sequential order in which critical issues should be reviewed in the context of an implementation plan, with the first three being of a general nature, creating a framework for incorporating the others. The guidelines are: (1) initial planning; (2) preparing for the computer's integration into the curriculum; (3) developing a comprehensive implementation plan; (4) reviewing software issues; (5) reviewing assistive device issues; (6) reviewing hardware issues; (7) providing the personnel to deliver the plan; (8) preparing staff to implement the plan; (9) assuring the plan's inclusion in the school system's operating plan; (10) evaluating implementation effectiveness and making adjustments; (11) sharing implementation resources and progress within the school system; (12) staying current with technological trends and research outside the school system; (13) encouraging active participation. Major recommendations are identified at the beginning of each section, followed by a detailed narrative. A summary, list of national resources, and suggested readings conclude the document. (JW)

ADMINISTRATIVE GUIDELINES FOR THE IMPLEMENTATION OF TECHNOLOGY IN SPECIAL EDUCATION



CEC ERIC

Linda Rice White

Published by The Council for Exceptional Children
A Product of the ERIC Clearinghouse on Handicapped and Gifted Children

Library of Congress Cataloging-in-Publication Data

White, Linda Rice.
Administrative guidelines for the implementation of technology in special education.
Bibliography: p.
1. Handicapped children—Education—United States—Data processing. 2. Computer-assisted instruction—United States. I. Title.
LC4024.W45 1987 371.9'028'5 87-15429
ISBN 0-86586-173-0

A Product of the ERIC Clearinghouse on Handicapped and Gifted Children

Published in 1987 by The Council for Exceptional Children, 1920 Association Drive, Reston, Virginia 22091-1589
Stock No. 319 Price $11.70

Office of Educational Research and Improvement

This publication was prepared with funding from the U.S. Department of Education, Office of Educational Research and Improvement, contract no. 400-84-0010. Contractors undertaking such projects under governemnt sponsorship are encouraged to express freely their judgment in professional and technical matters. Prior to publication the manuscript was submitted to The Council for Exceptional Children for critical review and determination of professional competence. This publication has met such standards. Points of view, however, do not necessarily represent the official view or opinions of either The Council for Exceptional Children or the Department of Education.

Printed in the United States of America.

Contents

About the Author v

Introduction 1

Guidelines 3

Guidelines Summary 42

Resources 43

BLANK PAGE

About the Author

Linda Rice White is the instructional technology specialist for the Department of Student Services and Special Education, Fairfax County Public Schools, Fairfax, Virginia. Dr. White received her B.A. and M.Ed. degrees in speech pathology from the University of Virginia and was awarded the Certificate of Clinical Competence from the American Speech and Language Association. She received her Ed.D. degree in school administration from Peabody College of Vanderbilt University in 1985. Her dissertation identified the relevant issues necessary to the effective implementation of microcomputers in public school special education. Current job responsibilities include: participant in special education technology implementation planning for over 14,000 handicapped students in 167 schools and centers; developer/presenter of training alternatives to assist special educators with the implementation of technology in the classroom; coordinator of resource support provided to administrators, teachers, students and parents. She has worked in this capacity since September 1983.

INTRODUCTION

School systems are purchasing microcomputers at an increasing rate throughout the United States. The manner in which a school system plans for and carries out the integration of this instructional tool has a major impact on its educational significance in both regular and special education programs.

Current literature documents the value of using computers with handicapped students. Applications are varied, depending on the specific disabilities of each child. The responsibility to meet students' unique needs has always been a major focus of special education, and the computer can assist with meeting many of those needs if its introduction is carefully planned. To accomplish this, administrators must develop both expertise in special education and technology and skills in determining where this new instructional tool will best complement and improve the educational process. A well-developed implementation plan employing the expertise of many educators in different disciplines must be developed in each school system. This cannot be left up to general education administrators alone. Special educators must take a more direct and active role in the implementation process if the computer's usefulness for all handicapped students is to be realized.

Guidelines for the instructional use of microcomputers in special education are presented to assist you with implementation planning and delivery. Emphasis is placed on the student's use of the computer as a tool and ways to ensure its effectiveness for all handicapped students. However, other forms of technology should not be excluded from your planning. Explore all the possibilities that may improve the educational program.

As you develop your implementation plan, consider four frames of reference from which administrative decisions should be made: humanistic, structural, political, and symbolic.

- Consider all aspects of the plan that will affect people. Many people are resistant to or intimidated by technology. The training you provide will have a major effect on the success of technology in the classroom. Staff development and resource support need to be planned very carefully.

- Every school system operates within its own structural framework. Knowing the operating procedures, the hierarchy, the protocol for information dissemination, etc., will greatly improve the success of your plan. Do not "buck" the system; instead, find the best ways to accomplish your goals by working effectively within it.
- Political considerations are critical to the success of your implementation plan. If it is going to be a part of the school's operating plan each year, the proper foundation and support from the community, school board, administration, and staff must be there to ensure that it will be included in the budget-decision process.
- Make a commitment to "sell" the importance of technology's entry into the instructional program for handicapped children on a continuous basis to all those involved in the plan. The justification for funding and supporting technology must be understood not only by those who will make the financial commitment, but also by those who will be involved in delivering the services. The more staff, students, school board, and community see the value of technology, the better chance you will have for a successful multiyear implementation of your plan. To ensure continual success, keep people informed and help them become working partners in the process.

The guidelines presented in this book discuss specific issues and are presented in the sequential order that critical issues should be reviewed in the context of an implementation plan. Guidelines 1, 2, and 3 are of a general nature, providing a framework for incorporating the others. Major recommendations for each guideline are bulleted at the beginning of each section, followed by a narrative discussing each statement.

Read the entire book first, and then refer back to specific sections as needed. Because these guidelines may be used over an extended period of time, recommendations are repeated at several points throughout the text to act as a reminder of their importance in your planning.

GUIDELINES

▾ Guideline 1 ▾

Initial Planning

- Begin with the philosophy that the microcomputer is a valuable instructional tool that is necessary for many educational objectives, including student vocational preparation.
- Have a clear purpose.
- Develop an awareness and a commitment to the role you, as a special educator, must play in effectively bringing the microcomputer into the instructional program for handicapped students.
- Explore many forms of technology and their impact on the educational process.

A strong belief in the value of microcomputers in instructional programs for handicapped students must be inherent in all you do in planning for implementation. You must be prepared to "sell" the concept to everyone involved—from the community and the school board all the way into the classroom. Your efforts to spread this philosophy must be continuous and should extend to all those involved. You will have to explain the commitment in time, talent, and money that will be required to ensure a significant role for the microcomputer in the educational process.

The computer should not be introduced into the instructional program as a replacement for existing teaching methods, but as another educational tool, which, when used properly, can improve curriculum delivery. One important requirement is your personal commitment to learning how to bring this technology into the classroom effectively. Investment in money and talent must be developed, and accountability for implementation must be addressed. Therefore it is essential for you to plan carefully and learn from the research and experience others have had in implementing microcomputers in public school special education.

Until now, general educators have led the way in introducing microcomputers into the instructional program. While many mainstreamed special education students have participated with general education students in computer use, little attention has been paid to their special needs in learning to use the computer. In addition, many handicapped students who are not in mainstreamed classes have not participated at all.

Therefore it is apparent that special educators must take a more active role in implementation planning and delivery. Without special educators encouraging computer applications for all handicapped students, it may be a long time before these students receive the same opportunities for computer exploration as their general education counterparts. Access to the microcomputer is now possible for even severely handicapped students, but unless you speak up for them, many of their educational experiences, which could be improved by computer access, will remain unchanged. You must take an active role in promoting the use of technology with special education students, "selling" its importance to all participants in the implementation process and developing a realistic and effective plan to ensure its place in the instructional program.

As you begin to develop your implementation plan, explore many forms of technology. Many augmentative communication devices for the nonverbal population, for example, use technology that is not associated with the microcomputer. Technology's impact on the educational process, vocational preparation, and in society as a whole, has only begun to be realized.

▼ Guideline 2 ▼

Preparing for the Computer's Integration into the Curriculum

- Identify the instructional goals and objectives that need to be addressed by every special education program.
- Designate a committee of special education representatives, technology resource people, and general education counterparts to work together and share their expertise in formulating your implementation plan. Encourage participation.
- Establish a special education committee to review all implementation issues. This group will plan, implement, and prepare evaluation procedures. The creation and composition of this group is critical for success.

- Explore current research on implementation of computers into special education and the recommended applications for instructional use.
- Assess the potential that technology can bring to the instructional program of handicapped children.
- Reexamine the instructional goals and objectives to be addressed in special education.
- Identify the objectives that would be improved by the use of the computer.
- Assess how the computer will be integrated into the classroom.
- Prioritize objectives involving computers over a multiyear plan taking into account the state of the art of available hardware, software, and assistive devices to meet those objectives.
- Develop a framework for a centrally controlled implementation plan that will include the school system's commitment to technology's role in educating handicapped students.
- Acknowledge that results will not be immediate, nor will they be achieved without sufficient support in time, talent, and money.
- Prepare to develop a long-range plan with a multiyear design.
- Always keep the future technological and societal needs of students in mind as you plan.

Identify Instructional Goals and Objectives

Each special education program determines specific student needs that should be addressed. These identified needs are then incorporated into the yearly school system operating plan. Begin here. Identify all your instructional objectives. Then collect special educators, technology resources (within the school system, if possible, or gain assistance from your state education department), and general education counterparts who can, as a team, provide both expertise in administrative and educational planning and support for bringing technology into the classroom. This group, or one established by them within special education, will plan, implement, oversee, and evaluate the microcomputer's effectiveness.

Much of this planning can be done cooperatively with general education personnel, and this will assist mainstreamed students in receiving computer opportunities with their classmates. However, the instructional needs of handicapped children cannot always be addressed through general education, especially those of children with moderate and severe disabilities. Therefore, the success of your implementation will depend on the blend of expertise in your group. You can work with general educators on issues relevant to both, but special educators with technological expertise are in the best position to determine computer applications and equity issues for handicapped students.

At the beginning, you may have to arrange for special educators and technology resource people to work together. As your committee's experiences with technology increase, you will be developing the most needed component in your planning: special educators with expertise in technology. It is not enough to know computers, you must also assess students' abilities, including their limitations and needs, and relate all of this to the value of the computer's use in their educational program. Explore the research for recommended microcomputer applications. If teachers and students have not been exposed to computers, provide them with hands-on training in the use of this technology in the classroom and look for quality software that will support your identified instructional objectives.

Exploration and staff training in the use of assistive devices will be needed to provide many handicapped students with computer access. (Resource information on this topic is included in Guideline 12.) In addition, you should initiate an exploration of how communication can be assisted through technology. The computer offers many new ways for improving the written and oral communication skills of handicapped students. As you explore the computer's role in communication assistance, you will also be working on student computer literacy skills, improving students' use of technology in the classroom, and opening the door for them to investigate additional instructional applications.

Assess Appropriate Computer Applications

Consider the following applications in your long-range planning:

1. Computer-assisted instruction (CAI).
2. Word processing (Part of CAI but of particular importance on its own).
3. Vocational assessment and career training.
4. Communication assistance.
5. Instruction in daily life skills.
6. Improvement in social skills and behavior management.

7. Recreational needs.
8. Motivation, self-esteem, and creative expression.
9. Computer management of instruction.
10. Environmental control.

As you reexamine your instructional objectives, many ideas will surface regarding how technology can help your program. A brief overview of the major instructional objectives that have been identified in current literature and research are discussed here to assist with your initial implementation planning.

Computer-Assisted Instruction. Computer-assisted instruction uses technology in the classroom as an alternative tool for learning. Instructional uses include tutorial and drill-and-practice presentations, simulations, tool applications, information management, and game-oriented programs for skill reinforcement. The software market continues to improve the quality of instructional programs available. Effective uses of CAI identified across special education programs include word processing to improve written expression; activities to enhance behavioral and social skills; and drill-and-practice software for the reinforcement of basic skills.

Applications that stress the computer's use as a tool are increasing, and teachers are finding effective ways to incorporate that tool into their daily activities. As students learn to use the computer to write, manipulate data, simulate learning experiences, and practice basic facts, they are also learning to use a tool for life.

Word Processing. Word processing is an excellent instructional use of the computer that should be included in your implementation plan. Through word processing, staff and students can gain a basic orientation to the necessary computer operations as well as learn the use of technology as a tool for writing. It can be used across the curriculum for students of all ages and special needs. The software market offers high-quality word processing programs to meet the diverse needs of handicapped children. The editing power of the computer, the excitement generated by students' seeing their work as it is printed, and the computer's ability to motivate children all coincide with the importance education places on the writing process.

Word processing activities can be incorporated into the traditional writing curriculum with ease. With a carefully planned computer use schedule, even limited hardware can accommodate this application, with children performing many phases of the writing process away from the computer (e.g., initial outlines, drafts, and editing/revising activities).

Drill and Practice. Many articles have been written disapproving of the use of technology for drill-and-practice activities. It should by no means be the sole use of computers in the classroom, but if the software is well designed, many handicapped students in need of reinforcement in basic skills may be helped by CAI.

Simulation. Instructional simulation software is increasing in quality and quantity. This is an area of CAI that holds enormous potential for students to experience the curriculum in ways not possible before the computer's presence in the classroom. Vocational and life skill training could be greatly improved through the use of simulation software.

Approach CAI applications carefully. Use your objectives based on their instructional importance for the students and the quality and quantity of hardware and software available to support your efforts.

Vocational Assessment and Career Training. Your implementation planning for student vocational assessment and career training should include the following objectives:

- Provide students in mainstream and center-based programs with the opportunity to explore computer-related careers through courses and information provided by guidance departments.
- Identify employment opportunities associated with technology that may be appropriate for handicapped students with a variety of abilities. If possible, pursue cooperative efforts with businesses and community sites to provide on-the-job computer training for the handicapped. Maintain employment resources to stay current with employment trends, entry employment requirements, training terminology, procedures, and materials. Establish a list of consultant resources for making program adaptations and identifying/evaluating commercially available training systems.
- Provide students with an opportunity to explore word processing, data base management, and programming concepts by integrating computer literacy and computer-assisted instruction activities into the program of studies.
- Develop instructional units within special vocational training components to address the relationship of special needs students and technological employment opportunities including word processing, data base applications, and office records management.

- Monitor student employment associated with technology to determine future instructional needs within special education programs. Establish a link with postsecondary service providers to ensure that programs are continuous and to ascertain whether or not postsecondary providers will take an active interest in providing assistance to the ongoing vocational programs in the school system.
- Explore other possibilities of technology's use in industry such as robotics and computer-assisted design. Stay current with industry's needs and opportunities.
- Keep abreast of the many other instructional applications for technology in special education.

Other Applications. *Communication assistance* is a means to augment the communication skills of nonverbal and nonvocal students. In recent years technology has become increasingly involved in this area. You should develop a comprehensive assessment and evaluation procedure for matching appropriate communication devices to individual students' unique needs. Identify a nonautomated (backup) system and an automated communication system for each student. More information on this procedure can be found in Guideline 5, as it relates to evaluating students who need assistive devices to access the computer through means other than the keyboard.

Environmental control refers to the use of computers by physically handicapped people to control radios, lights, and other electrical devices. These applications can increase self-sufficiency and independence and improve daily living. Another application, the use of robotics to improve an individual's ability to control other daily living functions, is just beginning to be explored.

The computer can also provide a new form of recreation and enjoyment to handicapped students through a variety of software programs and games. All of these applications are important and should be investigated on an ongoing basis for their potential in the instructional program.

Prepare a Multiyear Plan

Set priorities for your implementation objectives using a multiyear framework. Base your decisions on the following criteria:

1. The school system's commitment to the implementation plan.
2. The financial and personnel resources ensured for proper implementation of the plan.

3. The "state of the art" in technology and the availability of high-quality software to support your objectives.
4. Other school system priorities.

As you develop your plan, establish how you will attain the teacher and administrative support that will be necessary. Everyone involved— from community representatives, the school board, top management, and classroom teachers—must be exposed to your plan and provided with information to convince them of its importance for handicapped students. For this reason, a centrally developed plan is recommended, with involvement from top management to classroom teacher encouraged and expected.

Caution everyone that evidence of the computer's effectiveness in the classroom will not be immediately apparent, but that the end results are worth the commitment. Developing your implementation plan in a multiyear format will avoid shortsightedness and present those responsible for the approval of funds with a clear picture of where you are heading and how you expect to get there.

Finally, look toward the future in your planning and implementation delivery. Expect changes in both the technology and the expertise of staff and students and account for it. Expect technological changes that may affect curriculum delivery and content. This plan will not be static; expect adjustments and modifications. Needed changes will surface as you progress. Stay flexible in responding to implementation needs and build into your plan opportunities to make amendments in order to ensure the computer's classroom effectiveness. Guideline 3 will provide the framework for implementation planning.

▼ Guideline 3 ▼

Developing a Comprehensive Implementation Plan

- Select your curriculum targets carefully.
- Establish a realistic timetable for meeting objectives.
- Emphasize the use of technology as an instructional tool across special education applications and accommodate student assessment needs. Develop a procedure to assess each student's need for

appropriate computer applications in his or her instructional program.

- Review all issues related to staff training.
- Consider the role students will play in society, and technology's impact on vocational and life skills.
- Address the issue of equity of computer use.
- Identify who will be the facilitator and coordinator of technological resources for special education programs.
- Avoid fragmentation of job responsibilities as much as possible.
- Establish pilot computer projects before making a major implementation commitment.
- Build accountability into your plan.
- Consider implications for curriculum change as you progress.
- Capture the excitement that technology brings to education! Share this excitement with others and encourage participation and ownership of the plan by teachers and administrators.

Select Curriculum Targets

Integration of the computer into the curriculum should be the major focus of your planning. As you select curriculum objectives, consider the state of the art of the hardware and software. If the quality of the software or the capabilities of hardware cannot meet your objectives, alter your planning.

Consider the readiness of teachers and students to use technology effectively. Classroom implementation should be attempted only when the level of computer skill required matches their level of expertise. This will prevent many frustrating experiences in which effective learning is hindered or cannot take place. Remember, if there is a better instructional tool to accomplish curriculum objectives, it should be used.

Match the positive aspects of computer use with your instructional objectives carefully. Allow for flexibility of teaching styles. One teacher may accomplish the same objective in a very different way from another. The more you educate teachers to the potential uses of the computer, the more they will be able to determine the most effective use of it in their own classrooms. Teachers know their students' learning needs.

Develop components of your implementation plan that will evaluate the impact the computer has on the classroom. Many practical implementation questions can be answered by consulting with staff participating in this venture. Listen to their input.

Establish a Timetable

Establish a realistic timetable for accomplishing your plan's objectives. Evaluating progress will assist you in determining whether or not you are proceeding effectively and on schedule. Begin with instructional opportunities for staff and students to become computer literate, but continually move away from a structured computer literacy class toward instruction on the computer's use as an instructional tool as it relates to the specific needs of teachers across special education programs.

Review Issues

Review all issues. Even if your school system does not have any severely handicapped children, learn the steps necessary to ensure their access to computers and how to locate resource information should the need arise.

Include in your review a look beyond the classroom to the society in which your students will one day seek employment. You need to stay current with technology's impact on the community to match curriculum offerings with the skills students will have to possess. To do this, incorporate a procedure to ensure that any student who uses technology in the instructional program will be provided with the opportunity to explore all applications relevant to his or her education. A more comprehensive description of this procedure is provided in Guideline 5, Reviewing Assistive Device Issues.

Ensure Equity of Use

Equity of opportunity and access is important for students and staff. Special educators must take an active role to ensure that all handicapped children have the chance to explore the computer's use in their instructional program. A centralized plan helps to accomplish this.

Computer applications must be explored by all administrators and teachers as they relate to subject area and/or instructional objectives. If this is not done, inequity will result. Those who are intimidated or do not explore the computer's applications in education will not use computers with students. Unless you educate staff to computer uses, remove the intimidation that has been so consistently reported, and provide opportunities to explore classroom applications, the plan cannot be effective.

Identify Key Personnel

Identify who will be responsible for facilitating requests and coordinating resources for the different special education programs. This should include responding to teacher requests, coordinating general education computer plans with your own, and assisting administrators and parents in each special education program. If possible, create a new job position to handle these responsibilities. By doing so you will develop a focus and a common resource for staff to receive assistance and coordinate information that can be shared within the special education programs.

Fragmentation of job responsibilities can adversely affect the effectiveness of your implementation. Administrators with many responsibilities may not be able to give implementation the time and participation needed. Clarify all roles and who will have the responsibility for each assignment.

Establish Pilot Projects and Build in Accountability

Because of the commitment in time, talent, and money, initiate implementation on a small scale. You will learn valuable information from pilot projects that can make your major implementation more effective. This information also helps with accountability. Your plan must be evaluated to assess its effectiveness and justify the financial and personnel resources that have been provided.

Consider Implications for Change

As the expertise of teachers and students increases and technology offers new alternatives, be aware of the need to assess your curriculum and be willing to replace outdated content with more relevant and current material. The goal of education is to prepare students for life. It is critical that you stay current with the changes in society that will have impact on your students' lives. Technology applies to this issue.

Capture the Excitement

Technology generates excitement. Capture it, share it, and continuously assist others in "buying into" your commitment to its value as an instructional tool. As more people identify the importance of computer applications for handicapped students, and as the quality of available resources improves, your implementation plan now, and in the future, will become stronger.

This guideline provided the comprehensive framework for your implementation planning. Specific issues in need of review are presented in the guidelines that follow. Once you have identified the instructional objectives for implementation, begin to explore software and hardware issues.

▼ Guideline 4 ▼

Reviewing Software Issues

- Review the instructional objectives that you have selected to employ the computer as an alternative learning tool.
- Clarify who will be responsible for locating, previewing, and acquiring software.
- Seek software that follows a sound instructional design, meets your evaluation standard, and addresses your instructional objectives.
- Coordinate your efforts with general education. Your review of software should not be limited to programs marked only for special education.
- Explore the instructional possibilities of authoring languages and authoring software.
- Establish evaluation criteria for software approval.
- Show teachers and administrators how to evaluate software and provide them with resource materials and support.
- Establish preview library opportunities for teachers and administrators to evaluate software effectiveness with their students prior to purchase.
- Read license agreements carefully for each software program.
- Provide instruction to teachers and students on copyright and piracy issues.
- Provide resource support and instructional activities to assist with computer integration in the classroom, including keyboard training.
- Provide resource information on relevant issues before and after purchasing software.
- Explore all financial resources to support software purchases.

- Provide teachers and administrators with resources for locating quality software that will meet their instructional needs.

Review Software to Meet Objectives

Once you have selected the instructional objectives, a careful review of appropriate software should begin. A cooperative effort by teachers and administrators for reporting possible sources of quality software should be coordinated by an individual or committee whose responsibility is to locate and, if possible, acquire for preview, selected programs. Many products have well-planned advertisements. However, the only way to be certain that a software program meets instructional standards *and* your objectives is to preview the software. If this is not possible, a variety of qualified educational organizations publish lists of recommended software that has been evaluated. Some national sources have been included on the CEC Resource Sheet at the end of the Guidelines.

Look for software that meets your instructional objectives so that software will not be used in classrooms "just to be used." The software should not drive the curriculum, it must be the other way around. In the past, there was a lot of poor-quality educational software on the market, but programs are improving greatly now that educators are working with software programmers in identifying important objectives and appropriate delivery models.

Consider student and teacher needs in evaluating each software package. Make sure the software follows a valid instructional design and has clear explanations for operation, not only in the written documentation but especially on the software itself. Evaluate the content and format and keep in mind the students with whom it will be used. Make sure it is technically sound and free of operational defects.

Look for products that are motivating and can be adjusted for individual pacing and reinforcement needs. For example, if the program has sound, can it be controlled or turned off? Determine whether or not the child's participation with a program is the best instructional tool to accomplish your objectives. If not, it should not be used. Consider whether or not the amount of student participation and the input or response time is appropriate for the desired objectives.

The search for high-quality software should not be limited to programs that state they are for "special education." Software for general and special education should be based on the same basic instructional criteria. Many programs may be appropriate for both groups of students. Some may still need to be more specialized and contain criteria that meet the unique instructional needs of handicapped children. Coordinate your search with general education resources, but also review special needs resources.

Instructional software used within your school system should meet your evaluation criteria standards. Provide staff members with a list or report of all software that has been evaluated and found to be acceptable for use with students. Keep in mind that teachers do not always use the same teaching methods or styles. Different methods are used as required to meet the different learning styles of students. With proper training, teachers who know the technology and their students' needs will be in the best position to select from the approved instructional software list and use the computer effectively in their classrooms. Encourage everyone to assist in locating new software alternatives.

Progress Reports and CMI. Many instructional programs now provide a report of student progress as part of the software. This is especially helpful if the teacher can work with other students while one student uses the computer, and later be able to review the software program and determine what errors the student made and, in some cases, the frequency of the errors. This application facilitates planning for each student's future instruction. You should also explore computer management instruction (CMI) to facilitate many of the work-related responsibilities of administrators and teachers including word processing, data base management, records management, and spreadsheet applications.

Authoring Languages and Software. Authoring languages offer teachers the opportunity to have at their disposal software that allows their curriculum objectives to be merged with the software. In other words, the software can be adjusted to accommodate any instructional objective required. Programs of this type can greatly increase use of the computer by many teachers. They also can prevent misuse of student time in front of the computer for instructional objectives that do not match student need—a common criticism of software use in the past.

You should note, however, that if an authoring language is difficult to learn, there is almost no chance that it will be used by teachers. Most teachers do not have the time or the inclination to learn complicated procedures to incorporate instructional material into software programs. However, many programs are entering the market that do allow the simple entry of questions and answers.

These are the programs to identify. If possible, you should preview authoring language software prior to purchase. Many are not as easy as they claim to be.

Look beyond authoring language software to a more comprehensive type of authoring software with many applications in the classroom. Consider the term *authoring software* in its broadest sense. Software that allows you to take its skeleton format and amend it to specific instructional needs should be considered in this definition.

Initially, when hardware and software resources are limited, authoring software provides better instructional support because staff and students can use the computer across a wider range of instructional objectives. This can include word processing and instructional uses of data bases. (Many new programs are excellent in helping teachers and students learn to manipulate information in data base and graphing formats for their specific instructional objectives.) Game-oriented authoring software can also allow the teacher to control the content in a question/answer format and offer the student a pleasant activity to reinforce basic skill areas.

Other Software. Software designed for specific instructional objectives should also be reviewed, but many of these programs require a 1:1 or 2:1 ratio of student to computer for effective drill. If hardware resources do not permit an opportunity for this kind of classroom use, the authoring software may assist teachers more effectively by providing a tool to prepare for classroom instruction and permit more students to use the power of the computer for total class, small group, or individual activities on a rotating schedule. Word processing activities for student written expression work well in this format since activities such as outlining and editing drafts can be accomplished away from the computer. Limited hardware can be shared effectively if teachers carefully coordinate instructional activities that take into account the existing hardware and software resources.

Evaluate Software

Develop evaluation criteria for all software programs that will be used in your school system. Different programs will meet different teacher needs, but every software program available to teachers should be evaluated and approved as instructionally appropriate. Criteria already mentioned should be the basis of all evaluations. Educate your staff to the criteria. The more they know about what to look for in programs, the better their judgments for software use in the classroom will be. Provide them with evaluation criteria resources so that they may refer to them as needed. If possible, establish preview opportunities for teachers and administrators so that they can assess software effectiveness with students. Read license agreements on all software programs. Whether you can copy (share, etc.) programs is clearly stated on each software package. There are many differences in these agreements. *Read each one carefully.*

Previewing Software. Preview libraries of approved software (with the exception of public domain disks) may not loan programs for use by teachers in their classrooms in the same way a traditional school library loans books. What the preview library *should* do is provide a teacher or administrator with an opportunity to review a program and evaluate its effectiveness for a brief period. When this is done, money for instructional materials will be spent effectively.

Some software companies will allow a preview period. Explore this option whenever you find information on a product you would like to review. If the software is sent for review, be sure that your staff honors the company's policies and ensures its safety from damage or piracy. The reputation you build with companies may increase your preview options.

Provide instruction to administrators, teachers, and students on copyright and piracy issues. Software license agreements and copyright laws must be taken seriously, and this can only be accomplished if education is provided on what is and is not legal.

Provide Support

Assist administrators and teachers with learning the instructional uses of software and how to integrate computers into the classroom. Include drill-and-practice, tutorial, simulation, information-management, tool, and game-oriented applications as they would apply to different curriculum objectives. This removes some of the resistance and/or intimidation that may be experienced initially. One of the best ways is to demonstrate "success" stories of how special educators in similar instructional situations made use of technology.

If keyboard use is a problem for students, assistance with keyboard activities should be included. Many new software programs provide effective keyboard instruction directly on the computer. The issue of how much time should be devoted to this should be directly related to student proficiency. Students proceeding into computer courses at the secondary level must be trained to use the computer efficiently. At the elementary level, until research can clearly resolve this issue, incorporate keyboard instruction only to the extent that students need it to be comfortable with the computer or are frustrated by their inability to locate specific keys.

Provide resource support for ordering software and handling problems after purchase. Ordering software requires that the correct hardware, memory requirements, and version (e.g., disk) be identified. Teachers and administrators should also be aware of their options if damage occurs to the software program (e.g., the availability of a backup copy or replacement procedures). Resource materials and support can greatly reduce problems.

Explore all the financial resources available for purchasing software. Include in your budget estimates of required funds based on current software prices. Seek grant opportunities and donations. Parent groups may be helpful. Explore software companies and local stores for price differences. Many firms will give special discounts to school systems that buy in quantity. Regardless of how software is acquired, it should go through the evaluation process for instructional competency.

Keep your staff aware of programs that have been approved. Approved lists that describe content, subject, and hardware and memory requirements as well as student appropriateness can be a good starting point for individual teachers in their search for instructional software. Inside the school system, support can be provided by lists, libraries, newsletters, and meetings. Outside support can be provided from the community; technology and education conferences; magazines; vendors; and federal, state, and local organizations (mentioned in Guideline 12). Software issues must be reviewed closely with the two guidelines that follow: Reviewing Assistive Device Issues and Reviewing Hardware Issues.

▼ Guideline 5 ▼

Reviewing Assistive Device Issues

- Develop an assistive device inventory. Take into account student and hardware access that is needed.
- Develop a procedure to assess the most appropriate computer access for students in need of alternatives to the keyboard. Establish a committee to participate in the evaluation process.
- Identify who will be responsible for researching current assistive

device resources and communicating relevant information to the administrators in special education programs.

- Define the technical support that will be available within the school system and from each company when assistive devices are purchased.
- Identify funding resources inside and outside the school system for acquisition of necessary assistive devices.
- Take a more active role in seeking support from federal, state, and local agencies that may be able to assist in the location and acquisition of microcomputer assistive devices.

Build an Assistive Device Inventory

An essential issue in adopting the use of technology in the classroom is to make sure that students who cannot access the computer in the standard way (i.e., the keyboard) are provided with opportunities for computer literacy, computer-assisted instruction, vocational assessment and preparation, augmentative communication alternatives, improvements in daily living skills, and environmental control. One means of achieving this is through *assistive devices*, which, for the purposes of this discussion, refers to any input or output device or interface that allows an individual to use a computer by some means other than the standard equipment. It may be a keyguard device put over the keyboard to permit students with limited fine motor skills to use the keyboard or a braille printer to assist the blind.

If every handicapped child is going to be able to explore technology's role in the instructional program, the appropriate input/output device(s) must be determined, taking into consideration the uniqueness of each student's abilities. This requires that a procedure be established to coordinate the evaluation and assessment of a variety of assistive devices to meet the specific needs of each student. It also requires the development of an assistive device inventory that includes a variety of alternatives and an evaluation center where each student can be assessed.

Develop Evaluation Procedures

As appropriate, professionals including site and special education program administrators, classroom teachers, occupation therapists, hearing or vision consultants, psychologists, instructional technology specialists, physical therapists, speech/language pathologists, etc., and family members should be part of the evaluation team to match the appropriate device to each child. The following steps should be a part of the evaluation process:

1. Determine the student's use(s) of technology. Review the instructional needs of the student and assess technology's ability to assist with those needs.
2. Evaluate the student's functional and physical limitations. Is the condition constant? Is it degenerative? Include such areas as the student's degree of motor control, range of motion, muscle strength, physical endurance, and skills discrepancies in your evaluation.
3. Evaluate the student's aptitude and desire to learn to use technology.

You should design an evaluation procedure to address all of these issues and others identified from the assessment team's expertise and knowledge. The assessment procedure should be ongoing, with periodic check-up dates built into it. If possible, develop your plan of action with the assistance and advice of local, state, and national organizations, universities, and rehabilitation centers that have been involved with the evaluation of handicapped individuals using technology.

Select Appropriate Devices

Selection of devices is a complicated process. For example, equipment choices may include direct selection, encoding, and scanning options, and someone must be versed on the advantages and disadvantages of each kind, especially as they relate to each student to be assessed. Additional considerations include: identification of device sources, cost factors, portability of selected equipment, power requirements for selected devices, and follow-up training needs. Guideline 12 offers the names of many resources that may be helpful in establishing a bond with the appropriate agency or organization to help you get started with this critical component of your implementation plan. The success of technology in the instructional program for many of your physically and mentally handicapped students depends on it.

By developing an assistive device inventory and a student assessment procedure, the most appropriate device can be ascertained for each student's computer access. No one device is the answer for all children. Each must be explored carefully in relation to the capabilities of the student. The better the inventory for computer access, the better each student can explore the computer's value in the instructional program.

Be careful to take notice of the kinds of hardware requirements necessary for interfacing devices with the computer. The largest market of assistive devices access Apple IIe and IBM computers. Consider your instructional objectives, available quality software, assistive device access, and hardware as you try and make the actual selections.

Identify Resources

Staff. The existing demands on special education administrators' time could adversely affect the amount of participation available for exploration of this issue. Exploration of assistive device alternatives is time-consuming and *technically* involved, and many devices require significant programming skill. It would be most advantageous to provide a resource person who can assist with the technical expertise necessary to interface assistive devices with the computer. Job responsibilities would include reviewing current resources for all appropriate applications with handicapped students and assisting program specialists with available alternatives. This resource person would be a focus for all information requests and could explore specific special education computer requirements.

Funding. Funding is critical. Many devices are expensive and will require a firm financial commitment to support their role in the special education classroom. Equity demands that this issue be addressed. In order to allocate the needed support for computer acquisition, it may be necessary for you to voice the importance of this issue inside your school system and with local, state, and national funding sources.

The issue will continue to expand, and local systems, state agencies, and national organizations will be forced to examine their joint roles and responsibilities in assuring equal opportunity for all handicapped students. Without aid from outside agencies, school systems will have difficulty supporting the financial and personnel resource requirements necessary to evaluate students' assistive device needs across instructional applications, provide the technical assistance necessary to operate and maintain these devices on a continual basis, and establish an inventory of devices with a sufficient variety of input/output modes to meet the needs of students with a wide range of disabilities.

The expense of many assistive devices may be an enormous financial burden for many school systems. Once again, the importance of their use by handicapped students must be clearly reported to those responsible for implementation planning in order to ensure financial support. Resources for additional funds outside the school system may include business support, donations, and grants. Many local civic organizations, for example, are willing to support educational projects for handicapped students when they are presented with a clearly defined proposal including instructional objectives and estimated costs. How to locate these resources is discussed in Guideline 9.

▼ Guideline 6 ▼
Reviewing Hardware Issues

- Identify the specific instructional objectives and computer applications to be addressed.
- Identify as clearly as possible the software, peripherals, and assistive devices that will be required for implementation.
- Identify the hardware that best matches the targeted objectives for both short-term and long-term instructional objectives.
- Identify the building requirements that will be necessary to accommodate the equipment.
- Determine who will make hardware decisions and provide inside and outside resource support for the school system.
- Consider specific hardware requirements for targeted objectives.
- Whenever possible, purchase a hardware brand that accommodates multiple instructional objectives.
- Carefully plan financial support.
- Review a variety of building arrangements for housing the hardware.
- Provide the technical support required for maintenance, security, and repair from within the school system and/or without.

Match Hardware to Objectives

Before making any hardware decisions, review the computer applications and instructional objectives to be addressed. Review

Guideline 2 for recommended applications. Examine software and published reviews to determine what programs will enhance the objectives. Determine whether or not peripherals such as printers are important. Review assistive device requirements that will be necessary for many students to be able to access the microcomputer.

As much as possible, select one hardware brand to address the selected instructional objectives, but in some instances, different objectives will require different computer systems. Elementary computer-assisted instruction, for example, will not require the same sophisticated system necessary for business and data processing courses. Review all issues relevant to your planning.

Identify Building Requirements

Carefully determine the available space for hardware in each school or center. Include in your school planning future computer lab space as you do for the office or the library. Space must be assigned for computer use. Power strips, surge protectors, nonconductive safety pads, an adequate number of electrical outlets, and computer tables must be acquired. If computers are to be moved between classes, consider mobile carts to facilitate their use. This permits both laboratory- and individual-use alternatives in a school.

Appoint Decision Makers

The determination of who will make hardware decisions is critical. Whether a committee or an individual is given this responsibility, you should take into account (a) who will provide school system support for set up and operational questions and (b) who will provide technical repair and operational assistance. In addition, selected special education teachers who have computer expertise and will be using the computer as an instructional tool in their classrooms should have the opportunity to review the hardware choices and give input as to which keyboard, monitor, and other hardware components would be best for their students.

There are many differences in available computer systems. If your general education counterparts have a computer implementation plan, work with them in deciding these issues, especially if the same hardware is being used. But special educators with technical expertise, in consultation with technicians, should make many of the decisions that relate to handicapped students.

Consider Specific Hardware Requirements

Different instructional objectives may require different computer specifications. Examples include keyboard capabilities, visual presentations (monitor displays), memory requirements necessary to operate appropriate software, modems, assistive devices, and high quality software. Consider the following components as a minimum computer system:

1. A central processing unit with a minimum of 128K memory.
2. A monitor, preferably a color monitor that will support 80-column resolution.
3. One or two disk drives. (Other alternatives for storage such as a cassette recorder are too slow.)
4. A printer to provide hard copy of teacher and student work.
5. Peripheral inventories including a mouse, joystick paddle, graphics tablet, light pens, and new alternatives such as the Touch Window.™
6. Hardware that can accommodate an increase in memory, a modem, a speech synthesizer, or other assistive devices that may be needed.
7. A computer table, power strips, surge protectors, electrical outlets, and other equipment that supports computer operation.

Assistive Devices and Other Peripherals. A minimum of assistive devices should also be included at sites with students with moderate to severe physical and/or mental disabilities. Funding should be built into your plan to address this issue. Some alternatives may include speech synthesizers (these devices may help students in all special education programs if the speech clarity is adequate), keyguards, expanded keyboards, adaptive firmware cards, and a selection of single/multiple input switches. There are many alternatives to match the abilities of children with different handicapping conditions. In addition, many forms of technology other than the microcomputer are being used and explored, especially in the areas of augmentative communication for nonverbal children and environmental control for physically handicapped students.

As mentioned in Guideline 5, an inventory should be maintained and a procedure established to evaluate each student who needs assistive devices to use technology in the instructional program. It is not necessary, appropriate, or financially possible for every special education center to have every device. If an inventory is maintained and an evaluation process is used for each student, the appropriate device(s) should be provided for the student to use at his or her school or center. Note that many assistive devices are very expensive and funding alternatives inside and out of the school system should be explored. Suggestions are included in Guideline 9 to assist you in locating the sources of available devices, most of which access the Apple IIe and/or IBM PC computers.

In addition, there are other peripherals that might benefit children in special education programs. These include graphics tablets such as the Koala Pad and Power Pad, light pens, and screen-sensitive input devices such as the Touch Window. Most of these products work in connection with specialized software programs. Be sure to establish what programs are available for each device and whether or not there are versions available for your hardware.

Modems may offer another instructional use by permitting students and staff to communicate with one another via the computer as well as with national, state, and local data bases and organizations for resource information.

Plan Financial Support

Financial support should be carefully planned and publicized with the implementation plan. The commitment must be clearly established so that the individuals involved with approving funds will be well acquainted with the worth of the endeavor. Plan your resources over a long-range period. When your staff's computer training supports it, provide as much equipment as you can at the outset. Remember, pilot projects will help determine effective implementation issues including appropriate hardware-to-student computer ratio for each application.

Determine Hardware Arrangements and Provide Technical Support

Research has not indicated a clear preference for arrangements of hardware in the schools. You should provide school officials with a review of laboratory and classroom implementation ideas and allow them to match their plans with staff expertise and the instructional objectives to be addressed. Special educators with technological expertise can best decide how to take advantage of the available resources.

Be sure to provide technical support. Equipment will malfunction, and staff members may experience difficulty with hardware operations, especially at the beginning. Providing staff with reference material on the general operation of their hardware (e.g., turning on, running programs) can be of great assistance.

Repair and maintenance issues should be clarified either from an internal or an external source to assure that technical difficulties will be resolved quickly and effectively. Replacement and maintenance funding resources should be built into your implementation plan.

All of these issues are important, but without effective staff development to provide the foundation for your plan, technology will not be able to reach its potential in the classroom. Guidelines 7 and 8 review training alternatives in detail.

▼ Guideline 7 ▼

Providing the Personnel to Deliver Your Plan

- Clarify and assign all roles and responsibilities identified in your plan.
- Avoid fragmentation in job responsibilities.
- Assign a group or individual to coordinate technology resources in special education.

Administrators with many job responsibilities will not have sufficient time to devote to computer implementation. This can interfere with effective delivery. If possible, create an administrative or teacher resource position to act as a facilitator for all special education requests for information and assistance and ascertain current uses and technological advances that may assist the various special education programs. If this is not possible, clarification and sharing of implementation responsibilities will, improve the operation of the plan.

Time must be provided for staff to address plan objectives and implementation requirements. Work closely with the general education plan if one has been developed, but in order to address technology's impact on handicapped students, a special educator with technological expertise will assist administrators and teachers better with specific classroom needs.

As the staff receives training, special education technology resources will increase, both at the central and school level. Building on-site staff resources will greatly enhance teacher effectiveness with implementation as they work closely with the central plan in achieving instructional objectives. These staff resources can provide on-site assistance that will be expedient and beneficial.

As your implementation plan progresses, consider the need to increase your central coordination and resource personnel to meet requests for additional staff development, support, and information. The assistive device inventory and student evaluation procedure, discussed in Guideline 5, is another area that will demand increased personnel time. Continue to assess staff needs and plan accordingly. Expect increases in requests for central- and building-level resources for computer implementation as staff participation grows.

Clarify Roles and Responsibilities

As you explore the personnel required to deliver your plan, consider the following roles:

1. A special education instructional technology resource position to coordinate and facilitate implementation from the central administrative level.

2. On-site resource teachers who can facilitate classroom use.

3. Designers and presenters of relevant computer courses for handicapped students and of other staff development opportunities that will coordinate with the instructional objectives in your plan.

4. Resource personnel for hardware, software, and assistive device support. Many of the specialized devices used with the computer, including the adaptive firmware card and expanded keyboards, require programming skills. The need for this type of personnel support will increase as you progress further into implementation and provide more and more students with special devices. In addition, staff will be needed to establish and operate the assistive device inventory and coordinate it with student assessments. The more knowledge resource personnel have about the devices and their operation, the more valuable they will be to the evaluation team.

▾ Guideline 8 ▾

Preparing Staff to Implement Your Plan

Staff development issues are divided into two categories: planning for staff development, and topic and presentation targets.

Planning for Staff Development

- Address staff perceptions about computers and, in particular, the intimidation and resentment that beginners frequently feel.
- Address administrators, as well as teachers, in computer education.
- Identify needs of teachers and students. Instruction should go beyond operational procedures. Include training on how to integrate the computer in the classroom.
- Plan staff development topics in the sequential order that corresponds to instructional objectives, computer applications, and teacher expertise.
- Continue staff development throughout implementation and consider curriculum changes that may be necessary as staff and student expertise increases and technology provides new alternatives.
- Provide back-up support and work toward building on-site microcomputer resources.
- Build in time and funding for teachers and administrators to participate in staff development options. This should include staff participation in local, state, and national technology conferences.
- Remember that staff education needs will change with levels of expertise and changes in technology.
- Provide parents with inservice opportunities.
- Provide computer access to everyone receiving staff development training.
- Acquire information from pilot experiences for improvement of staff development content.
- Identify special education resource support during implementation.

- Provide resource support that is varied, abundant, and accessible to all staff members involved in implementation and/or training for implementation. This must include follow-up assistance.
- Determine how you will assess teacher competency with microcomputers.
- Consider problems with teacher turnover and training.
- Allocate the financial and personnel resources necessary for effective staff development efforts.

Address Perceptions. Technology elicits intimidation and resentment in many teachers. If this barrier is not broken, computer use for those individuals and their students will never be able to develop fully. Staff members should be encouraged to "share ownership" of computer planning and implementation and become a part of the excitement generated by this instructional tool. This applies to administrators as well as teachers. Heretofore there has not been enough emphasis on administrator participation in training. Administrators have a major impact on their teachers and, with computer expertise, can provide an essential resource for effective implementation planning and delivery. Administrative ownership can also increase the financial commitment to your implementation plan from other sources responsible for special education program funding.

Provide Staff Training and Back-Up Support. Administrators and teachers with computer experience in the classroom should assist in the identification of classroom needs to improve the computer's effective use. It is not enough to teach operational procedures. The list of topics at the end of this narrative includes a variety of targets for staff development. Training topics should be presented in a sequential order, with a hands-on format, and coincide with the instructional objectives and computer uses in the classroom and the expertise levels of personnel. It may be necessary to consider curriculum changes as the expertise of students and teachers increases and technology offers new alternatives for education and vocational preparation.

Continue staff development throughout the implementation process. Provide back-up support and approach training with the intent to increase staff expertise to the point where each school or center will have its own on- site resource support as well as the centrally organized support that will be provided from the beginning.

Plan time blocks for training carefully to allow staff the opportunity to participate. Offer variations in time, format, and presentation topics to accommodate the many needs of administrators and teachers. Provide information and funding for selected staff to attend local, state, and national conferences. Information on current technology and instructional applications can be obtained from these sessions, and attendance by staff can also encourage their active participation in implementation planning and delivery. Parent involvement should also be provided and encouraged. Everyone involved with implementation must understand the value of technology for handicapped students. By accomplishing this, your implementation will be more effective now and in the future.

A key component for successful staff development is the assurance that all those receiving training will have access to hardware and software resources to practice what they have learned and prepare for classroom use. If hardware and software access is not available, frustration and/or resistance to using technology may result. Schedule training objectives that match realistic hardware access. The balance is very important.

If pilot projects are undertaken before school-system-wide implementation, many effective and ineffective aspects of your plan can be identified. Information learned from these experiences can greatly improve staff development.

Provide Resource Support and Plan for Assessing Teacher Competency. Clearly identify special education resource support. If your general education counterparts provide resources, coordinate your activities with them. However, as stated in earlier guidelines, the development of special educators with computer expertise is important to the identification of technology's full value for handicapped students. If a resource position can be established, teachers and administrators from all special education programs could request support through a common source and more effectively and equitably receive needed assistance and resource support. As more special educators in each program become computer literate, more resource support will continually be available. Work toward this level of support in each special education program at every school site, and coordinate needs with the identified central resource person or committee.

Resource support should be provided in a variety of formats in order to accommodate the learning styles of all personnel involved in implementation. No one medium will provide all the assistance needed. Follow-up support is important. Training sessions must be followed with opportunities to review what was learned and to ask for help as requested. Also, there will be a need to address how teacher turnover will affect classroom implementation.

As your plan progresses, develop measures to assess teacher computer competencies as related to individual teaching responsibilities. This may be accomplished by a formal assessment, a requirement in course work, or more informal measurements. If this is left undone, teachers who resist computer use because of intimidation or other reasons will not provide opportunities for their students to use the microcomputer as an instructional alternative.

Be sure the financial and personnel commitment necessary for effective staff development is secured. This includes trainers, resource support, and personnel to design and present inservice topics and explore staff development format alternatives.

Topic and Presentation Targets

- Select a computer language that is appropriate for your students. In general, LOGO is recommended for elementary and BASIC for secondary students. This should be only one component of computer literacy training.
- Provide staff development in a variety of formats in order to meet the many needs of administrators and teachers, and accommodate their time for training.
- Coordinate topics for training with the instructional objectives and computer applications in the implementation plan.

Select a Language. Computer languages for computer literacy should be selected on the basis of student population. LOGO is recommended for elementary students and moderately retarded students, and BASIC for secondary students. A computer language should only be one component of this course. Learning to use technology as an instructional tool should remain the focus of computer literacy. Many of the books and resources suggested in Guideline 12 will be of assistance in computer literacy curriculum planning.

Provide Staff Training That Is Coordinated with Objectives. For computer literacy and other topics to be addressed, employ as many formats as possible to provide training opportunities to administrators and teachers who have different instructional needs and time schedules. Formats suggested include 1- and 3-hour college and noncollege credit courses, inservice training sessions, newsletters, handouts, prepared hardware/software reference guides, summer curriculum workshops, electronic bulletin boards, and resource personnel.

Most important, the topics for training must coincide with the instructional objectives and the computer applications that are to be implemented in the classroom. Consider the following list as a beginning reference for your own planning. Topics should be presented at different computer competency levels corresponding to the computer expertise of students and staff. Some topics could be grouped for presentation. Focus on your identified instructional objectives in making your topic selection.

1. Computer literacy and the basics of operation (including appropriate programming languages).
2. Use of the computer as an instructional tool and the various ways to implement it, including the most effective classroom presentations for different objectives and special needs students.
3. Avoiding fragmentation of computer use in the classroom by scheduling computer access effectively.
4. Keyboard training (and/or assistive device orientation and training).
5. Classroom logistics for implementation.
6. How to use the strengths of the computer to improve instruction.
7. Curriculum integration techniques and activities.
8. Word processing applications.
9. Available resource support.
10. How to share hardware and software resources.
11. Alternatives for computer lab and individual classroom scheduling.
12. Use of authoring languages and software to match instructional objectives.
13. Evaluation of instructional software.
14. Software preview and evaluation procedures.
15. Software resources that are available for specific curriculum needs.
16. Software copyright and piracy issues.
17. Assessing student readiness for computer use and the specific difficulties that should be explored before student access.
18. Instructional and vocational applications including word processing, data base, and spreadsheet applications.

19. Communication assistance and environmental control through technology: how to work with selected assistive devices.
20. Overview presentation of computer applications for handicapped students.
21. Use of computer management of instruction for administrative and teacher work-related activities.

At this stage of planning, attention should begin to focus on how to assure the inclusion of your plan in the school system's yearly operating plan, both now and in the future. The next two guidelines provide assistance in this area.

▼ Guideline 9 ▼

Assuring the Plan's Inclusion in Your School System's Operating Plan

- Budget carefully for all financial considerations in your plan.
- Present your implementation plan and its importance for handicapped students to all groups involved with evaluating the plan and funding it.
- Define the financial commitment *after* you have designed the plan, not before.
- "Sell" the importance of your plan to ensure that its long-range financial requirements will be met.
- Continue to oversee and evaluate the effectiveness of your long-range implementation plan.

Determine Financial Requirements

Being aware of the financial requirements to implement your plan is critical. Once your school system's funding support has been assured, additional resources can be explored to augment the delivery or increase the rate of delivery. Resources outside the school system include assistance from federal, state, and local grants, donations, parent groups, local business interests, microcomputer companies, and projects that link business and education.

In addition, continue to educate various groups such as the superintendent's advisory council and the school board to the worth of your plan. It is crucial to assist all those involved in implementation decisions with their understanding that the costs are greatly outweighed by the end result, and that the plan's effectiveness will be monitored continuously. Implementation of technology in the classroom cannot be done quickly or without cost.

To the greatest extent possible, determine the funding requirements after the initial plan has been developed so the plan will better meet the needs of the students. Funding limitations should not determine the implementation. If funding is limited, it may cause you to prioritize the implementation activity schedule more carefully and/or adjust the delivery time table. Adjustments can be made more effectively from the comprehensive plan while additional revenue is sought to support full implementation.

Focus on Long-Range Planning

Avoid shortsighted decisions concerning implementation. All objectives and implementation planning should be reviewed in terms of a long-range commitment with clearly defined long-range plans. Only in this way can the adjustments to existing plans be seen from a realistic and effective vantage point and assure the effective instructional use of technology. If your ongoing assessment cannot clearly support the benefit of the computer in the classroom, financial backing may be reduced or eliminated entirely. Assessment recommendations are discussed in Guideline 10.

▼ Guideline 10 ▼

Evaluating Implementation Effectiveness and Making Adjustments

- Continue to evaluate program effectiveness on all activities undertaken.
- Stay flexible enough to adjust existing plans as warranted.
- Consult teachers, administrators, technical support personnel, and others involved in your implementation process in making major decisions.

- Provide progress reports and feedback opportunities on a regular basis to everyone involved in the implementation process.
- Stay current with technological advances and their implications for the instructional program for handicapped students, now and in the future.
- Evaluate your implementation plan for educational impact and accountability.
- Identify the need to increase existing staff support. Increase personnel as needed to address emerging roles and applications that arise during implementation.

Assess Program Effectiveness and Make Adjustments

Assess your implementation progress during each year and formally review plan effectiveness once a year. Be flexible to amend, adjust, and adapt the plan as implementation progress directs and as new applications of the computer in the classroom are identified. Assessment may begin with the committee that designed the implementation plan, but should also include feedback from teachers and administrators in each special education program and participants in the general education computer plan. This combination of feedback will provide the needed information to assess your plan and prepare for future implementation.

Monitoring of implementation activities provides an invaluable resource for effective planning. Take advantage of it. As adjustments in approaches or timetable become necessary, make them. The plan will be more beneficial to teachers and students. Be sure to consult with selected teachers and groups actively involved with implementation and learn from their experiences. This is another example of special education expertise and technology united. Teachers have the responsibility for making the microcomputer an effective tool in the classroom. Their experiences can greatly affect present and future planning decisions. The same is true for administrators and other staff resources. Sharing resource alternatives within school systems will be reviewed in Guideline 11.

Keep Up with Technological Advances

Technology is changing at an incredible rate, and special education administrators must assume the responsibility to stay up to date on current computer advances and their future implications for and impact on the educational process. Adjustments need to be made to your implementation plan as changes become significant to the instructional uses of technology and the preparation of students for their role in society. Suggestions for staying current with technological trends and research are included in Guideline 12.

Evaluate Educational Impact and Accountability

The importance of assessing the effectiveness of your implementation plan must be addressed. Financial allocations for technology implementation in the multiyear plan must be reviewed each year within the normal budget process of your school system. Other system-wide priorities may be vying for the same funds, and the importance of your plan must continue to be made apparent in the political arena where financial decisions are made. The commitments in time, talent, and money demand accountability. Assessing progress during implementation allows you to make adjustments that can improve the entire program. Some of the reasons for program adjustment include:

1. Changes in technology.
2. Changes in the expertise of students and teachers.
3. Changes in curriculum content.
4. New requirements in need of consideration that were not discussed in the initial planning.
5. Changes to accommodate more realistic timelines for attaining implementation objectives.

As the expertise of staff increases, the staff development programs and the instructional objectives should be amended to match staff competence and the quality of hardware, software, and assistive devices available for classroom application. This may require adding staff positions that were not necessary at the beginning of implementation.

Evaluations should not be done solely in response to school system accountability for expenditures. This is important, but planned assessment also provides the opportunity to review what is working and what is not and make needed adjustments. This assists in ensuring plan success. Design your assessments around your implementation projects. In this way, evaluations will reflect specific projects and offer valuable information on how to proceed. Because you are implementing over a long- range schedule, self-evaluation is very important and must be continuous. Guidelines 11 and 12 offer suggestions for sharing implementation resources for evaluation and instructional support.

▼ Guideline 11 ▼

Sharing Implementation Resources and Progress Within the School System

- Plan who will coordinate information sharing.
- Coordinate information gathering and sharing with general education.
- Determine how to share resources.
- Select effective formats for information sharing.

A common resource person available to all special educators is helpful in coordinating similar concerns and directing information to all special education programs that would benefit. This does not mean that each special education program would not address this on its own, but a facilitator aware of all projects and current progress would be in the best position to assist staff members with their specific implementation activities. Identify who will provide this service. If possible, assign a special educator with computer expertise. Also, if the general education program includes instructional technology personnel, coordinate the gathering and sharing of available information and resources with them.

Central dissemination initially will assure all special education programs the opportunity to be aware of relevant resources and implementation progress as they relate to specific program needs. In addition, effective sharing can encourage teachers and administrators to become more actively involved and "buy into" the implementation process.

In an attempt to reach the widest audience, resource information should be provided in a variety of formats, depending on the needs of the staff and the specific audience for which it is intended. Examples include newsletters, flyers, electronic bulletin boards, staff bulletin boards, school system magazines, user groups, meetings, computer courses, inservice sessions, memos, individual resource people, and curriculum workshops.

Information sharing should coincide with the opportunity for those receiving the information to participate and share in the exploration. Frustration results when a teacher's excitement about participating is dampened by the lack of facilities and hardware to begin. Conversely, if a teacher receives hardware and software but has not received guidance on their use, similar frustration or misuse of the computer can occur. Information sharing should be carefully planned.

▼ Guideline 12 ▼

Staying Current with Technological Trends and Research Outside the School System

- Identify who will be responsible for this function.
- Review a variety of available resources for support, information, and financial assistance.
- Evaluate your own implementation and share the findings with others.
- Participate in efforts to bring the educational importance of technology for handicapped students to the attention of those in positions of influence.

Teachers and administrators should share resources they discover. If there is a facilitator—a common special education resource for sharing— information can be shared more easily to benefit students across many programs. Resources are available in a wide variety of formats and from a wide variety of sources at the federal, state, and local levels. A list of some resources for information, support, and financial assistance follows:

1. The U.S. Department of Education, Office of Special Education and Rehabilitation Services, Washington, DC.
2. Federal projects such as the Center for Special Education Technology, Reston, Virginia.
3. The Special Education Software Center, Menlo Park, California.
4. The technology division of your state department of education.
5. Vendors.
6. Course offerings from universities, colleges, companies, and neighboring school systems.

7. National and local conferences and conventions on the handicapped and technology.
8. Special education and technology magazines.
9. Presentations.
10. Electronic networks such as SpecialNet.
11. The Trace Center at the University of Wisconsin.
12. Closing the Gap publications and conferences.
13. Professional organizations.
14. Current research and reports.
15. Information from and/or visitations to other school systems to assess their implementation plans and progress.
16. Local health organizations.
17. Parent groups.
18. Local businesses.
19. Books written specifically for special education use of microcomputers.
20. Other school systems.

Many of these resources can provide additional information in areas you request. As an example, the Center for Special Education Technology provides a variety of appropriate resources on the use of microcomputers with handicapped students and serves as an excellent starting point for future information. In addition, many local businesses will participate in computer projects that provide students with vocational training in technology. Research as many resources as time will permit. Assistance can be obtained in many forms. Many current books on the subject of microcomputers and the handicapped provide lists of resources for further information. Several lists are included at the end of this book.

As you progress in your implementation plan, gather your evaluation and assessment results and find ways to share this information with others outside the school system. Research on implementation success has been minimal, and school systems need to share what has been effective. In addition, as the opportunities arise, provide written publications and oral presentations to support the benefits technology is bringing to the education of handicapped students. This will increase awareness and support for your plan and increase the resources available to other school systems in their implementation planning and delivery. Guideline 13 addresses this issue. Its importance cannot be overstated.

▼ Guideline 13 ▼

A Call for Active Participation

- Participate actively in voicing the importance of technology in special education to federal, state, and local agencies.
- Share your implementation plan with others.

It is essential for the importance of computer applications for handicapped students to receive more attention. There are many roles that the federal, state, and local governments could play if those in influential positions were more aware of computer potential in the classroom. Your position on the "front line" provides you with significant information on the relevancy of this tool in special education. As you learn more about computer technology and blend this with your expertise in the education of handicapped students, you are in the best position to determine effective implementation now and in the future. This could provide invaluable political impact on the availability of technology for your students.

Stay current with technological changes and explore new options. Consider the role computers can play not only in an instructional setting but also in preparing your handicapped students to be active, participating members of society. Psychological, social, and vocational applications can be enhanced through computer experiences. Build your case and share it with those who could assist in making a difference!

Take the time to share your implementation experiences with other school systems, companies, and governmental agencies. What you are discovering may assist others in their exploration, as well as set the stage for future applications that have not been discovered. You will have contributed to the limited knowledge base for use of technology in special education. Make the time. It will benefit handicapped children everywhere.

▼ Guideline Summary ▼

Many issues must be carefully examined and resolved in order to use microcomputers as an effective instructional tool in special education classrooms. Attention must be given to all necessary considerations for uniting technology and special education programs. These guidelines synthesize the relevant data on technology's implementation in special education and present those data in a format to assist administrators involved in bringing microcomputers into instructional programs for handicapped students.

Although field research on microcomputer use in public school education has been limited, it is only through research and the sharing of implementation experiences among school systems that more effective delivery issues and methods can be developed.

The guidelines also provide a framework for implementing the use of the microcomputer in the classroom. It is the responsibility of all of us who have experienced the microcomputer's potential for enhancing the education of handicapped students to share our information with national, state, and local resources. We must build more national awareness; share more resources; develop better instructional planning and delivery procedures; assist the developers of hardware, software, and assistive devices with improvements that are needed for educational objectives; and educate teachers and administrators to the potential uses of the computer in the instructional program.

We must provide educators with the computer training to assist with instructional delivery decisions. They already possess the special education expertise. When we can match their expertise with sufficient resources to support their investigation of how to use technology effectively for their students' educational needs, we will truly be on the threshold of discovering what microcomputers can do for handicapped students. All special educators should participate in this challenge, keeping abreast of the technological requirements and applications as they continue to change and expand.

A list of suggested national resources provided by The Council for Exceptional Children and a list of suggested readings have been included on the following pages to provide additional support for implementation planning and delivery.

Resources

▾ Publications ▾

Augmentative and Alternative Communication
Williams & Wilkins
P.O. Box 1496
Baltimore, MD 21203

Communication Outlook
Artificial Language Laboratory
Michigan State University
405 Computer Center
East Lansing, MI 48824

Computer Disability News
National Easter Seal Society
2023 West Ogden Avenue
Chicago, IL 60612

Learning Disabilities Focus
Division of Learning Disabilities
The Council for Exceptional Children
1920 Association Drive
Reston, VA 22091-1589

Rehabilitation Technology Review
Rehabilitation Engineering Society of North America
Suite 700
1101 Connecticut Avenue, NW
Washington, DC 20036
202/857-1199

▾ Centers and Projects ▾

ABLEDATA
National Rehabilitation Information Center
Catholic University of America
4407 Eighth Street, NE
Washington, DC 20017
202/635-5826

ADDS
Assistive Device Center
6000 J Street
Sacramento, CA 95819

Apple Computer, Inc.
Office of Special Education Programs
20525 Mariani Avenue
Cupertino, CA 95014
408/996-1010

COPH-2
Committee on Personal Computers & the Handicapped
2030 Irving Park Road
Chicago, IL 60618

The Center for Special Education Technology
The Council for Exceptional Children
1920 Association Drive
Reston, VA 22091-1589
1-800-345-TECH

Closing the Gap
P.O. Box 68
Henderson, MN 560[illegible]

[illegible]SENSE
University of Connecticut
U-64, Room 227
249 Glenbrook Road
Storrs, CT 06268
203/486-4033 or 4034

ERIC Clearinghouse on Handicapped and Gifted Children
1920 Association Drive
Reston, VA 22091-1589
703/620-3660

FDLRS/East
1450 Martin Boulevard
Merritt Island, FL 32952
305/631-1911

International Council for Computers in Education (ICCE)
Department of Computer and Information Science
University of Oregon
1787 Agate Street
Eugene, OR 97403
503/686-4414

International Society for Augmentative and Alternative Communication (ISAAC)
P.O. Box 1762, Station R
Toronto, Ontario
Canada M4G 4A3

Microcomputer Information Coordination Center (MICC)
139 CRU, UKMC
39th and Rainbow
Kansas City, KS 66103
913/588-5985

Missouri LINC
University of Missouri
609 Maryland Avenue
Columbia, MO 65211

Pennsylvania Assistive Device Center
Central Pennsylvania Special Education Resource Ctr.
Elizabethtown Hospital and Rehabilitation Center
Elizabethtown, PA 17022

Project ACCESS
Oakland Public Schools
2100 Pontiac Lake Road
Pontiac, MI 48045
313/858-1903

Rehabilitation Engineering Society of North America (RESNA)
Suite 700
1101 Connecticut Avenue, NW
Washington, DC 20036
202/857-1199

SECTOR Project
UMC-68
Utah State University
Logan, UT 84322

SpecialNet
National Association of State Directors of Special Education
Suite 315
2021 K Street, NW
Washington, DC 20006
202/296-1800

Special Education Software
Center
Building B, Room S312
333 Ravenswood Avenue
Menlo Park, CA 94025
1-800-223-2711—TA
1-800-327-5892—Information

TechCentral, AECT
1126 16th Street, NW
Washington, DC 20036
202/466-4780

Technology and Media Division
The Council for Exceptional
Children
1920 Association Drive
Reston, VA 22091-1589
703/620-3660

▼ Additional Readings on Implementation Issues ▼

Anandam, K., & Kelly, T. (1984, November). Teaching and technology: Closing the gap. *T.H.E. Journal,* 84-90.

Anderson, R. E., & Klassen, D. L. (1981, Spring). A conceptual framework for developing computer literacy instruction. *AEDS Journal,* 128-150.

Association for Children and Adults with Learning Disabilities (ACLD). (1984). *Newsbrief, 1,* 1.

Bennett, R. E. (1982). Applications of microcomputer technology to special education. *Exceptional Children, 49*(2), 106- 113.

Bitter, G. G., & Wells, M. (1983, November/December). First step in utilizing microcomputers in education: Preparing computer literate teachers. *Monitor,* 19-21.

Blaschke, C. L. (1985, February). Teaching trends in special education. *T.H.E. Journal,* 73-77.

Bozeman, W. C. (1984, May). Strategic planning for computer based educational technology. *Educational Technology,* 23-27.

Braun, J. C., & Slobodzian, K. A. (1982). Can computers teach values? *Educational Leadership, 39,* 508-510.

Browning, P., & Nave, G. (1983). Computer technology for the handicapped: A literature profile. *The Computing Teacher, 10*(6), 56-59.

Budoff, M., & Hutten, L. R. (1982). Microcomputers in special Education: Promises and pitfalls. *Exceptional Children, 49,* 123-128.

Budoff, M., Thormann, J., & Gras, A. (1984). *Microcomputers in special education.* Cambridge, MA: Brookline Press.

Cain, E. J. (1984). Computer literacy: Daily living competencies for the handicapped. In M. Behrman & L. Lahm (Eds.), *Proceedings of the National Conference on the Use of Microcomputers in Special Education, Hartford, Conn., March 10-12, 1983* (24-27). Reston, VA: ERIC Clearinghouse on Handicapped and Gifted Children, The Council for Exceptional Children.

Carman, G. O., & Kosberg, B. (1982). Educational technology research: Computer technology and the education of emotionally handicapped children. *Educational Technology*, 22(2), 26-30. Cogen, V. (1969). The computer's role in education and use with the exceptional child. *Mental Retardation*, 7(4), 38-41.

Crowner, T. T. (n.d.). *Exceptional children and microcomputers: A survey of public school applications*. Unpublished manuscript, San Diego State University.

Davis, N. C. (1983, February). Yes they can! Computer literacy for special education students. *The Computing Teacher*, 64-67.

Dede, C. (1983). Symposium: The future of computers in education—the likely evolution of computer use in schools. *Educational Leadership*, *41*(1), 22.

Diem, R. A. (1982). Education and computer technology: Some unresolved issues. *Educational Technology*, 22, 19-20.

Edwards, J., Norton, S., Taylor, S., Weiss, M., & Van Dusseldorp, R. (1975). How effective is CAI? A review of the research. *Educational Leadership*, *33*, 147-153.

Educational Research Service, Inc. (1982). *School district uses of computer technology*. Arlington, VA: Author.

Fiske, E. (1983, August). Computer education: Update '83, Parts 1, 2, 3. *Popular Computing*, 86-113.

Foulds, R. (1982). Applications of microcomputers in education of the physically disabled child. *Exceptional Children*, *49*, 155-162.

Geoffrion, L. D., & Goldenberg, E. P. (1981). Computer-based exploratory learning systems for communication-handicapped children. *Journal of Special Education*, *15*, 325-332.

Gerber, C. H. (1983, March). Educational Computing: There's a lot to learn. *Today*, 16-22.

Gleason, G. (1981). Microcomputers in education: The state of the art. *Educational Technology*, *21*(3), 7-18.

Golden, F. (1982, May 3). Here come the microkids. *Time*, 50-56.

Goldenberg, E. P. (1979). *Special technology for special children*. Baltimore, MD: University Park Press.

Gray, P. (1983). Organizing for microcomputers in school districts. *Research on Evaluation Programs*, *16*(1), 2-4.

Grimes, L. (1981). Computers are for kids: Designing software programs to avoid problems of learning. *TEACHING Exceptional Children, 14*(2), 49-53.

Hagen, D. (1984). *Microcomputer resource book for special education.* Reston, VA: Reston Publishing.

Hanley, T. V. (1983a, October). *Microcomputers in special education: Organizing issues.* Washington, DC: U.S. Department of Education, Special Education Programs and SRA Technologies and COSMOS Corporation.

Hanley, T. V. (1983b). *Microcomputer software in special education: Selection and management.* Washington, DC: U.S. Department of Education, Special Education Programs and SRA Technologies and COSMOS Corporation.

Hannaford, A. E. (1983). Microcomputers in special education: Some new opportunities, some old problems. *Computing Teacher, 10*(6), 11-17.

Hannaford, A. E., & Sloane, E. (1981). Microcomputers: Powerful learning tools with proper programming. *TEACHING Exceptional Children, 14*(2), 54-57.

Harper, D. O., & Stewart, J. H. (1983). *Run: Computer education.* Monterey, CA: Brooks/Cole.

Hartley, S. S. (1977). Meta analysis of the effects of individually paced instructions in mathematics. *Dissertation Abstracts International, 38*(7-A), 4003.

Hasselbring, T. S. (1982). Remediating spelling problems of learning-handicapped students through the use of microcomputers. *Educational Technology, 22*(4), 31-32.

Hathaway, M. D. (1984). Variables of computer screen display and how they affect learning. *Educational Technology, 24*(1), 7-11.

Hofmeister, A. M. (1982). Microcomputers in perspective. *Exceptional Children, 49,* 115-121.

Jamison, D., Suppes, P., & Wells, S. (1974). The effectiveness of alternative instructional media: A survey. *Review of Educational Research, 44,* 1-61.

Johns Hopkins University. (1983). *School uses of microcomputers: Reports from a national survey.* Baltimore, MD: Author.

Johnson, E. L. (1984, January). Computing and handicapped education. *Educational Computer,* 27-29.

Joiner, L., Sedlak, R., Silverstein, B., & Vensel, G. (1980). Microcomputers: An available technology for special education. *Journal of Special Education Technology, 3*(2), 37-41.

Karoff, P. (1983, April 17). Computers: Too much too soon? *Washington Post,* 15, 22.

Kulik, R. L., Bangert, R. L., & Williams, G. (1983). Effects of computer based teaching on secondary school students. *Journal of Educational Psychology, 75*(1), 19-26.

Lewis, R. B., & Rossett, A. (1980). Educational technology as perceived by special educators. *Journal of Special Education Technology, 3*(2), 43-49.

Lindsey, M. (1981). *State of the art report: Computers and the handicapped.* Eugene, OR: Northwest Regional Educational Laboratory.

Lipkin, J. P. (1983). Equity in computer education. *Educational Leadership, 41*(1), 26.

Loebl, D., & Kantrov, I. (1984). Natural partners: Technology and special education. *Electronic Learning, 3*(5), 37-39.

Luehrman, A. (1982, January/February). Computer literacy. *Monitor,* 20-21.

Maddux, C. D. (1984). Using microcomputers with the learning disabled: Will the potential be realized? *Educational Computer, 4*(1), 31-32.

Magidson, E. M. (1978). Issue overview: Trends in computer assisted instruction. *Educational Technology, 18,* 5-8.

Miller, J. (1982). Word processing: Lessons loud and clear. *Softalk,* 2(7), 158-160, 162.

Myers, W. (Ed.). (1982). *Personal computers aid the handicapped.* [Reprinted from *IEEE MICRO,* Los Alametos, CA.]

National Education Association. (1982). *Computers in the classroom: A NEA survey report.* Washington, DC: Author.

National School Board of America Computer Alliance. (1983). *Computerwise, 1*(4), 1.

National School Board of America Computer Alliance. (1984). *Computerwise, 2*(2), 1, 7.

Neill, S. B. (1983, November). How to plan for effective instructional use of microcomputers. *NAASP Tips for Principals,* n.p.

Poore, J. H., & Hamblen, J. W. (1984, Spring). Why computer based education is making slow progress: An analysis of costs and other impediments. *AEDS Journal,* 42-52.

Quinn, J., Kirkman, J., & Schultz, C. (1983). Beyond computer literacy. *Educational Leadership, 41*(1), 38.

Rogosta, M. (1983). Computer assisted instruction and compensatory education: A longitudinal analysis. *Machine Mediated Learning, 1*(1), 97-126.

Randhawa, B. S., & Hunt, D. (1984, Spring). Computers and computer literacy in contemporary psychological, sociological, economic, and educational context. *AEDS Journal,* 1-13.

Senf, G. M. (1983). Learning disabilities challenge coursework. *The Computing Teacher, 10*(6), 18-19.

Sheingold, K. (1981). *Issues related to the implementation of computer technology in schools: A cross-sectional study.* Preliminary report presented to National Institute of Education Conference on Issues Related to Implementation of Computer Technology in Schools, Washington, DC.

Shively, J. E. (1984, Spring). Computer utilization in education: Problems and prerequisites. *AEDS Journal*, 25-33.

Skinner, K. (1982). An exploratory study of the trends of microcomputers in education and preliminary considerations for determining an implementation strategy. (Doctoral dissertation, Peabody College of Vanderbilt University.) *Dissertation Abstracts International*, DE 082-27072.

Stallard, C. K. (1982). Computers and education for exceptional children: Emerging applications. *Exceptional Children, 49* 102-104.

Taber, F. M. (1981). The microcomputer: Its applicability to special education. *Focus on Exceptional Children, 14*(2), 1- 13.

Taber, F. M. (1983). *Microcomputers in special education: Selection and decision-making process.* Reston, VA: The Council for Exceptional Children.

Thelan, H. (1977). Profit for the private sector. *Phi Delta Kappan, 58,* 458.

Thorkildsen, R., & Williams, J. G. (1981). *A brief review of current status of computers in special education.* Logan: Utah State University, Exceptional children.

Trachtman, P. (1984, February). Putting computers into the hands of children without language. *Smithsonian*, 42-51.

Tuckman, B. W. (1984, May). Why (and why not) teach computer use? *Educational Technology*, 35.

United States House of Representatives. (1982, September 14). *Informational technology and its impact on American education.* (Joint hearing before the Subcommittee on Elementary, Secondary, and Vocational Education and the Subcommittee on Select Education of the Committee on Education and Labor). Washington, DC: Author.

Uslan, D. T. (1982). Classifying and locating special education software. *The Catalyst, 1*(3), 4-5.

Vanderheiden, G. C. (1982). Computers can play a dual role for disabled individuals. *BYTE, 7*(9), 136-162.

Vinsonhaler, J. F., & Bass, R. K. (1972). Summary of ten major studies on CAI drill and practice. *Educational Technology, 12,* 29-32.

Walker, D. (1983). Reflections on educational potential and limitations on microcomputers. *Phi Delta Kappan, 65*(2), 103-107.

Watkins, M. W., & Webb, C. (1981). Computer assisted instruction with learning disabled students. *Educational Computers, 1*(3), 24-27.

Watson, P. (1979). The utilization of the computer with the hearing impaired and the handicapped. *American Annals of the Deaf, 24*, 670-680.

White, G. (1984). Microcomputers for the special education administrator. *Electronic Learning, 3*(5), 39-40.

Wrege, R., & Watt, D. (1982, November). Forum on educational computing. *Popular Computing*, 132-141.